

inflatable bag 20 is securely fastened to the end of inlet tube 22 in a fluid tight manner.

An outlet tube 38 also passes through cap 14 and permits fluid flow from the interior of chamber 24 through outlet tube 38 and exhaust port 40, as indicated by arrow 42, to the exterior of sampler 10. Within outlet tube 38 a solenoid valve 44 is provided to permit cutoff of the outlet flow. Further, a pump 46 within outlet tube 38 is connected to a pump shaft 48 which passes through the closed outer end of outlet tube 38. A propeller 50 is provided on the outer end of pump shaft 48. Preferably, inlet tube 22 extends forward of cap 14 a greater distance than does outlet tube 38 so that the water discharged through exhaust port 48 does not contaminate the sample drawn into inlet tube 22. A filler tube 52 also passes through cap 14 and is provided with a closure plug 54 at its outer end.

In order to obtain a sample of a flowing fluid, solenoid valve 44 is closed, plug 54 is removed from filler tube 52, and chamber 24 is filled with water or other appropriate fluid through filler tube 52. When the chamber is entirely full, plug 54 is reinserted into filler tube 52. The water assures that inflatable bag 20 is deflated. The isokinetic fluid sampler is then placed in the flowing fluid stream at the location from which a sample is desired. When sampling in a river or other body of flowing water, the sampler may be lowered by a cable to the desired sampling point. An electrical conductor within that cable permits control of solenoid valve 44. When the sampler is properly positioned, solenoid valve 44 is opened, and the flowing stream causes propeller 50 to rotate, driving pump 46. The water from within chamber 24 is pumped out exhaust port 40. Since chamber 24 is completely sealed, the flowing fluid is drawn into inlet tube 22, as indicated by arrow 23, to inflate bag 20, replacing the exhausted water. Propeller 50 is driven by the flowing fluid, pump 46 exhausts water from chamber 24 at a rate proportional to the flow rate of the flowing fluid, and the proportionality is based on the ratio of the internal diameters of outlet tube 38 and inlet tube 22 so that the sample enters inlet tube 22 and chamber 24 with the same flow rate as the flow stream. Consequently, the sample is obtained isokinetically. Further, since pump 46 is not in inlet tube 22, the sample is not contaminated by the pump.

Once the desired sample is obtained, solenoid valve 44 is closed, and the sampler is removed from the flowing stream. Latches 16 are opened, and the flexible bag 20, with the fluid sample within it, is removed from the end of inlet tube 22, providing the desired sample.

If desired, solenoid valve 44 can be open as the isokinetic fluid sampler is lowered into the flow stream so as to obtain a depth-averaged sample.

FIG. 3 depicts an alternative form of a pump which can be utilized with the fluid sampler. In the pump of FIG. 3, propeller 50 is connected by shaft 48' to controller 56 which is connected by cable 58 to motor 60. The shaft 62 of pump 46' is driven by motor 60. Propeller 50 provides controller 56 with an indication of the flow rate of the flowing stream, and in response controller 56 controls the speed at which motor 60 operates so that pump 46' pumps the water from chamber 24 at a rate proportional to the flow rate of the flowing fluid, just as in the embodiment of FIG. 1. Controller 56 can be controlled by signals in an electrical conductor within the cable by which the sampler is lowered into the flow stream, just as is solenoid valve 44.

Whereas in the embodiment of FIG. 1, propeller 50 serves as a flow impeller to power pump 46 at a rate to cause the water or other fluid to be exhausted from chamber 24 at an

exhaust rate proportional to the flow rate of the flowing stream, in the embodiment of FIG. 3 propeller 50 serves as a flow rate sensor to provide controller 56 with a signal indicative of the flow rate of the flowing fluid.

The fluid controlled isokinetic fluid sampler of the present invention can be operated at any depth, even below the 17 foot depth of many existing samplers. Further, because chamber 24 contains no air, the vertical transit rate of the sampler is not limited by the compression rate of air as are many existing samplers. The absence of air in the sampler also eliminates any need for a heavy housing or harness to provide stability. Additionally, the fluid sampler of the present invention can obtain samples even in flow streams of low velocity. In extremely low velocity flow streams, the motor driven pump of FIG. 3 can be utilized to assure obtaining the sample isokinetically. Since the pump and valves are separated from the sample inlet path, the sample is not contaminated by these components. The sampler can be readily and quickly reused in the field by simply unlatching the cap from the housing and removing bag 20 containing the sample. If desired, inlet tube 22 can be designed to be easily removed from cap 14 and the more laborious cleaning of inlet tube 22 can be deferred until the sampling is completed, and it is not necessary to clean the sampler inlet tube in the field.

The isokinetic fluid sampler can be used to obtain samples of flowing gases, as well as flowing liquids, if desired. Thus, for example, vehicle exhaust gas might be sampled. However, it is usually not necessary that flowing gases be sampled isokinetically. If desired, housing 12 can be made of a transparent material such as plexiglass to permit viewing of inflatable bag 20 as soon as the sampler is removed from the flow stream.

Although the present invention has been described with reference to preferred embodiments, various substitutions, rearrangements, and alterations can be made and still the result would be within the scope of the invention.

What is claimed is:

1. A fluid controlled isokinetic fluid sampler for obtaining a sample of a flowing fluid, said fluid sampler comprising: a fluid tight container adapted to be filled with liquid; an inflatable bag within said container and in fluid communication with the exterior of said container;

means for withdrawing liquid from said container at a flow rate proportional to the flow rate of the flowing fluid to cause a sample of the flowing fluid to be drawn into said inflatable bag at a rate equal to the flow rate of the flowing fluid, to inflate said bag within said container so as to replace the liquid withdrawn from the container.

2. A fluid controlled isokinetic fluid sampler as claimed in claim 1, wherein said inflatable bag includes an inlet tube communicating the interior of said bag with the exterior of said container; said fluid sampler further comprising an outlet tube connected to said container, a pump for pumping the liquid from the container through said outlet tube and to the exterior of said container, and means for driving said pump at a speed to withdraw the liquid from the container at a rate proportional to the flow rate of the flowing fluid, wherein the ratio of the flow rate of the liquid pumped through said outlet tube to the flow rate of the flowing fluid is substantially equal to the ratio of the interior diameter of said inlet tube to the interior diameter of said outlet tube.

3. A fluid controlled isokinetic fluid sampler for obtaining a sample of a flowing fluid, said fluid sampler comprising: a hollow closed housing adapted to hold a liquid;